International Journal of Business
Management & Research (IJBMR)
ISSN(P): 2249-6920; ISSN(E): 2249-8036
Vol. 6, Issue 2, Apr 2016, 1-14

TRANS STELLAR
•Journal Publications •Research Consultancy

Original Article

A STUDY AND DEVELOPMENT OF COMPREHENSIVE SOLID WASTE MANAGEMENT PLAN FOR PANCHAYAT UNIONS IN COIMBATORE DISTRICT UNDER THE CONTEXT OF MUNICIPAL SOLID WASTE RULES

THA. MURUGAN[1]& R. CHANDRASEKARAN[2]

[1]*Research Scholar, Bharathiar University, Coimbatore, Tamil Nadu, India*

[2]*Director, Dept. of Management Studies, Karpagam College of Engineering, Coimbatore, Tamil Nadu, India*

ABSTRACT

Currently, the major challenges for municipalities and panchayats are handling of rapid increase in solid wastes owing to rapid growth of population and changing life styles has resulted in increased waste generation. Solid waste management which was hitherto an urban problem has become a major challenge of the rural local bodies.

Due to non-availability of adequate expertise and experience these local bodies lack technical, managerial, administrative, financial resources, adequate institutional arrangements suffer handling of solid waste management which resulting into creation of environmental pollution and health hazards. Consequently, waste management has become a key issue needing to be addressed.

A local body at panchayat union has the responsibility of handling of Solid Waste. Solid waste management strategies adopted by the local bodies include management of Solid Waste at compost depot, segregation of waste into degradable and non-degradable, management of biomedical waste, conversion of waste into wealth, and implementation of Municipal Solid Waste (MSW) rules. With increase in population, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into panchayat waste collection centers were collected and segregated for conversion and the residual thrown into the landfills and dumps. However, either due to resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final dumpsites. If at this stage the management and disposal is improperly done, it can cause serious impacts on health and problems to the surrounding environment.

This research identify, implement, and/or maintain programs for ensuring that solid wastes are managed in accordance with Municipal Solid Waste rules in a manner that protects public health, safety, identify and implement emerging methods for improved management, emphasize the development and implementation of the most efficient technologies for waste reduction, create wealth by reuse/recycling and create an efficient and effective system of waste stream measurement and monitoring.

KEYWORDS: Solid Waste Management, Environmental Pollution, Biodegradable, Non Biodegradable, Recycling

Received: Jan 20, 2016**; Accepted:** Feb 21, 2016**; Published:** Mar 03, 2016**; Paper Id.:** IJBMRAPR20161

INTRODUCTION

Waste is defined as any unwanted material that is due for discarding. But technically, waste is considered as a resource in the wrong place (Abdullahi Y.A, 2011). Waste is something for which we have no further use and which we wish to get rid of. Solid wastes arise from unusable residues in raw materials, leftovers, rejects and scrap from process operations, used or scrap packaging materials and even the saleable products themselves when they

are finally discarded. Equally, Waste is defined as any substance or object which the holder discards or intends to discard. Solid waste can be classified based on composition, source as well as physico-chemical properties. The classes of solid waste based on source are: municipal (domestic, institutional and commercial), agricultural, mining and mineral, radioactive and industrial wastes. Among these sources, industrial and municipal wastes contribute the highest volume annually (Victor and Choji, 2006). For the purpose of this study, municipal solid waste is considered. Waste collection, sorting and recycling in the informal sector is characterized by small-scale, labour-intensive, largely unregulated and unregistered, low technology manufacturing or provision of services.

Generally, Informal sector entrepreneurs or enterprises do not pay taxes, have no trading license and are not included in social welfare or government insurance schemes (Haan, Coad, and Lardinois, 1998). In the context of Municipal solid waste management (MSWM), the informal recycling sector refers to the waste recycling activities of itinerant waste collectors, scavengers and waste pickers. These terms are used to describe those involved in the extraction of recyclable and reusable materials from mixed waste. These activities epitomized the informal sector as this is labour intensive, low technology and low-paid, unrecorded and unregulated work. The principal goal of Municipal Solid Waste Management is to protect public health. Other goals include promotion of environmental quality and sustainability, support of economic productivity and employment generation (Wilson, Whiteman, and Tormin, 2001).

It is on record that rapid increase in volume and types of solid waste as a result of continuous economic growth, urbanization and industrialization, is becoming an intractable problem for public and private sectors to ensure effective and sustainable management of waste across the world. It is estimated that in 2006 the total amount of municipal solid waste (MSW) generated globally reached 2.02 billion tones, representing a 7% annual increase since 2003 (UNEP, 2009 report). It is further estimated that between 2007 and 2011, global generation of municipal waste has risen 37.3%, equivalent to roughly 8% increase per year.

India is the second largest nation in the world, with a population of 1.21 billion, accounting for nearly 18% of world's human population, but it does not have enough resources or adequate systems in place to treat its solid wastes (Coad, A and Coffey, M. 2008). Its urban population grew at a rate of 31.8% during the last decade to 377 million, which is greater than the entire population of US, the third largest country in the world according to population. India is facing a sharp contrast between its increasing urban population and available services and resources. Solid waste management (SWM) is one such service where India has an enormous gap to fill (Puri A. and Kumar, M. 2008). Proper municipal solid waste (MSW) disposal systems to address the burgeoning amount of wastes are absent. The current SWM services are inefficient, incur heavy expenditure and are so low as to be a potential threat to the public health and environmental quality. Improper solid waste management deteriorates public health, causes environmental pollution, accelerates natural resources degradation, causes climate change and greatly impacts the quality of life of citizens (Upadhyay V P et al., 2005).

Generation of Waste

Kurudampalayam village Panchayat is located adjacent to Coimbatore Corporation, Tamilnadu. It is split into 4 wards; each ward consisting of 3400 houses (approx) and a total of 13600 houses. Its total population is about 33000. The CASTAS project covers approximately 3400 houses in 4 wards, 8500 (approx) people reside in these 4 wards. This is a DRDA initiative, joining hands with the SHGs and NGOs. This Panchayat comes up with a state of the art waste management system. They are resourcefully converting their day-to-day residential waste into wealth and products. This village stands as a role model for its counterparts. They have a well-established cyclic process for waste collection,

segregation and recycling. The Table 1 below depicts the zone wise population and respective waste generation in tones per day

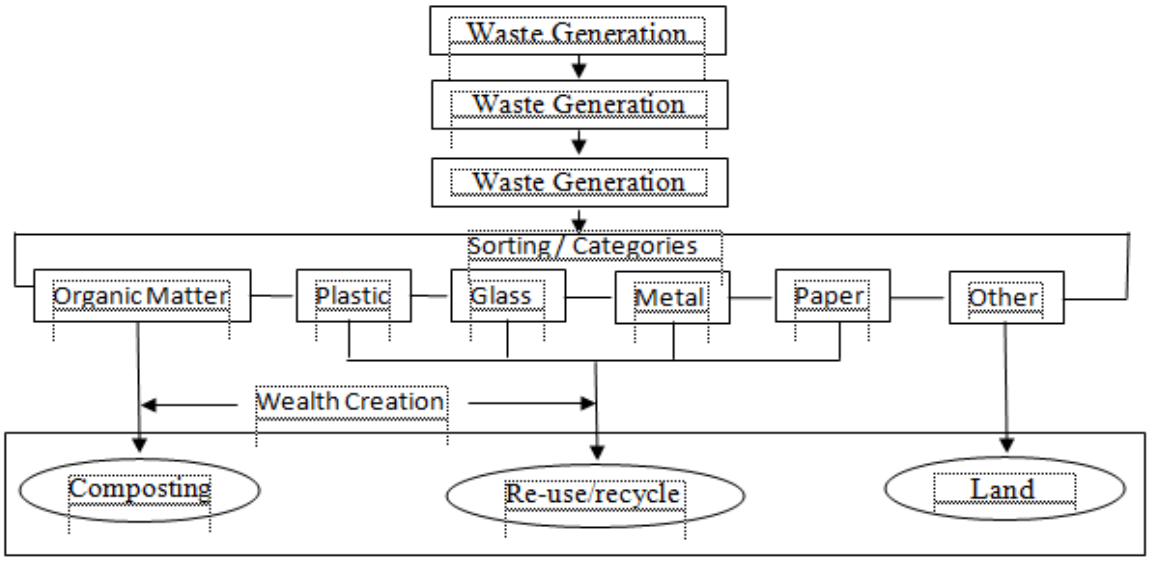

Figure 1: Integrated Solid Waste Management Model

Table 1: Zone Wise Population and Total Solid Waste Generated

S. No.	Name	Population	Waste Generation (TPD)
1	Ward 1	2100	0.632
2	Ward 2	2050	0.622
3	Ward 3	2200	0.667
4	Ward 4	2150	0.643
Total Waste Generated in Tons/Day			**2.564**

SOLID WASTE MANAGEMENT PLAN

- **Waste Segregation Process**

There are 36 workers in the Cash out of Trash (CASTAS) team, with split up schedules for each day according to the team which sets out to collect waste from the houses allotted to them. The waste collection takes place twice a day in shifts; the first shift is from morning 7:00am to 10:00am and the second from 3:00pm to 5:00pm in the evening. The waste is collected in a specially designed vehicle that has the following features:

- The vehicle is designed and promoted by DRDA, Coimbatore. It operates on battery and does not require registration or licensed drivers, anyone above the age of 18 are eligible to drive it.
- The vehicle takes 8 hours to charge and runs for 80km at a stretch, at a maximum speed of 25km/hr.
- The vehicle has both front as well as rear gears. It has a total load capacity of 300kg
- apart from the driver load. Three passengers can travel on the vehicle in its front seat.
- The vehicle is exclusively designed for waste collection and segregation; the container which carries the load is split into three compartments with removable Partitions

Figure 2: Collection Vehicle is Designed and Developed by DRDA

LEVEL OF SEGREGATION

First Level Segregation - Segregation At Home

Initially in order to give awareness to all the families in the Panchayat, the ward councillor, Panchayat president and few workers go on an orientation walk to all houses to guide them with the first step of collecting waste in different baskets. based on whether it is organic or inorganic waste, they are all supplied with two coloured baskets per household where bio-degradable waste are placed in the green basket and non-biodegradable waste in the red basket respectively.

This step concludes the first level of waste segregation that takes place at home. When the waste collection vehicle comes for collection twice a day, the wastes are filled in respective partitioned portions of the vehicle. Based on the average amount of waste collected in each

Figure 3: Waste Collection and First Level Segregation

Partition in a particular ward, the partition in the vehicle is adjusted so as to provide more space for biodegradable or non-biodegradable waste accordingly.

Every morning when the workers arrive, the schedule for that particular day is put up on the board, according to which the workers proceed to their respective wards. This cyclic routine is monitored by the Self Help Group (SHG), Vallarai Suya Uthavikuzhu.

Second Level Segregation

The waste thus collected is brought to the waste segregation shed for second level segregation. Though proper guidance and awareness has been given to the families, many people fail to segregate the waste perfectly; hence all the wastes are collected and re-segregated as per different categories of waste material and their respective usages. In the shed

the workers pile the waste into two categories as mentioned previously and arrange few collection buckets around them. Then the wastes are divided into subcategories based on its materials as follows:

- A total of 20 category buckets are used for organic waste separation and 21 for inorganic waste collection. The organic waste is separated based on its categories here itself and the inorganic waste are collected in the remaining 21 buckets together without subdivision and taken to tertiary segregation.

A typical Solid waste comprises of biodegradable, non biodegradable and debris matter as given in Table 2 for Kurudampalayam village. The laboratory analysis of waste encompasses both physical and chemical characteristics and is given below in the form of tables. The chemical characteristics of MSW are depicted in Table 3 and physical characteristics of the MSW are depicted in Table 4.

Table 2: Classification of Waste

S. No.	Type of Waste	% Ton
1.	Recyclable	45.95
2.	Biodegradable	26.00
3.	Debris and Silt	28.05

Table 3: Chemical Characteristics of Solid Waste

Test Report				
Report No:	**Alt/4090/2014**		**Report Date:**	**26.05.2014**
Customer Name & Address		**M/S. VALLARAI MAGALIR KUZHU, KRUDAMPALAYAM PANJAYAT, COIMBATORE**		
Sample Details		SAMBAL- 2		
Sample reference no:		ALT/MAY/OT-10764	Sample collected date	--
Customer Reference		Verbal Work Order	Sample received on	19.05.2014
Sampling Procedure		---	Analysis started on	19.05.2014
Sample Collected by		Customer	Analysis completed on	26.05.2014
SL.NO.	**PARAMETERS**	**METHOD**	**UNITS**	**RESULT**
1	Nitrogen	IS 3025 (P-34) - 1988(RA-2003)	%	0.83
2	Phosphorus	IS 3025 (P-31) - 1988(RA-2003)	ppm	896.91
3	Potassium	IS 3025 (P-45) - 1993(RA-2003)	ppm	110
4	Sodium	IS 3025 (P-45) - 1993(RA-2003)	ppm	180
5	Calcium	IS 3025 (P-40) - 1991(RA-2003)	ppm	4390.28
6	Magnesium	3500 Mg B APHA 22nd Edition 2012	ppm	634.27
7	Sulphate	4500 $SO4^2$ - -E APHA 22nd Edition 2012	ppm	5625.2
8	Chloride	IS 3025 (P-32) - 1988(RA-2003)	ppm	9721.01
9	PH	IS 3025 (P-11) - 1983(RA-2002)	-	10.77
10	Electrical Conductivity	2510 B APHA 22nd Edition 2012	(umhos/cm)	589
11	Total Plate Count	FDA-BAM 8th Edn. (Rev A) 1998 (Latest Edtn. Jan 2001) Chapter 3 Page - 3.01 - 3.05	cfu/ml	59

Note: BDL – Below detectable Limit

Approved by: Checked By:

Note: The result shown in the report is valid to the sample and should not be reported in any case unless with a written approval from Alpha Labs & Technologies

Table 4: Physical Characteristics of the Solid Waste

S. No.	Parameter	Value
1.	Fruit /Vegetable waste	19.42 %
2.	Paper	1.86 %
3.	Plastic	8.92 %
4.	Cloth	2.46 %
5.	Wood	1.53 %
6.	Metals	0.32 %
7.	Glass	0.82 %
8.	Leather	0.42 %
9.	Rags	0.95 %
10.	Rubber	0.06 %
11.	Pebbles	13.82 %
12.	Fine Sand	26.24 %
13.	Ash and fine earth	21.18 %
14.	Moisture	7.66 %
15.	Density	440 Kg/cum

(**Source:** *Alpha Labs & Technologies, 261-C Thadagam Road, Opp. Avila Convent, Velandipalayam, Coimbatore – 641 025*)

Figure 4: Second Level Segregation

WASTE RECYCLING PROCESS

Coconut Waste Recycling Process

- Coconut shells are processed and the sponges are separated, collected and is distributed to rope making factories.
- The shell portion is used for manufacturing several articles such as mosquito coils, Ice-cream box, and to manufacture a main component of a water purifier unit.

Figure 5: Coconut Waste Recycling

Egg Shell Recycling Process

- Egg shells are used for making fertilizer as it is rich in nitrogen, phosphorous, potassium and calcium. The egg shells are washed initially and then dried, after a couple of days it is ground and sold at a rate of 350-400/kg.
- The egg shell powder is used as fertilizer for roof garden etc.

Figure 6: Egg Shell Recycling

FRUIT PEEL RECYCLING PROCESS

- The citric fruits peel (peels of orange, lemon and sweet lime) is used for making washing powder and toilet cleaning powder. These peels are split based on its categories as grade1 and grade2 peels. The peels collected on the same day are identified based on its colour when it is fresh; this is collected as grade1 peel and is washed and dried. The peels which are little older and are in the stage of decomposing are also washed twice, dried and collected as grade2 peel.
- In order to manufacture the washing powder a mixture of 60% of grade1 peel,15%soapnut oil, 10% cow dung ash and 15% acacia concinna powder(shikakai shrub) are all powdered, mixed and ground.
- Toilet cleaning liquid is manufactured by a mix of 80% grade1 peel, 5% soapnut oil, 10%cow dung ash, 5%concinna powder. It has antibacterial characteristics with a pleasant odour.
- The dish wash powder market rate costs around Rs 80-90 per kg and toilet cleaning liquid in the market it costs Rs 50-60.

COMPOST BED PROCESS

The organic wastes which are not edible for cattle and not suitable for any of the above mentioned processes are collected together and processed to form a compost bed which has a chain of processes and applications. There are two types of compost bed formed, indoor and outdoor compost bed. The step by step process required to form the compost bed and its applications are discussed below.

Indoor Compost Bed

- The organic waste is first soaked in a mixture of cow dung and water and laid on a platform of measuring 9ft X 4ft

- The platform is surrounded by a trench of water on all sides with fishes circulating on it.
- Each day the organic wastes are processed as mentioned above and laid as layers over and over the previous day layers.
- After approximately 15 days of such formation of layers the bed formed raises to a height of 2 to 3 feet, and then it is covered with jute sack all around the bed.
- For the next 45 days this bed formation is watered twice a day, once in the morning and evening. During this process, decomposition takes place inside the compost bed.
- The temp inside the compost bed rises to 80-85^{o}C and in order to reduce this internal temperate the bed is watered as mentioned-speeding up the decomposition process. The brought down by 10-15^{o}C by the watering process
- During the decomposition process organic waste, a house fly tend to breed and lays eggs over this bed. These eggs hatch to form larva, which crawl out of the bed due to the high temperature into the water trenches. Thus to control and eliminate these larvae, fishes are circulated in the water trench around the bed, which feed on these larvae and hence eliminates the growth of houseflies in its first stage itself. Since the average life of a housefly is 40 to 45 days, the parent group is also eliminated over the period.
- After 45 days this bed layer is removed and sieved. The decomposed materials get filtered in powder form which is sold for a cost of Rs.10.
- The partially decomposed materials remain in the sieve and are again, laid back on the compost bed. Few materials like banana leaves take a longer period to decompose comparatively hence the remains from the sieve are placed on the bed on each cycle after filtration until it gets totally decomposed.

Figure 7: Inside Composite Bed

Outdoor Compost Bed

- The only difference between the indoor and outdoor compost bed is that in outdoor bed the job of fish is replaced by ducks or frogs.
- Ducks as well as frogs also feed on these larvae and hence eliminate the houseflies.
- The capacity of outdoor compost bed is not limited and it can be expanded as needed as it is laid on bare ground

and not on a fixed platform.

- The outdoor bed is usually designed to 9 X 3 feet rectangular form.
- The same process of decomposition and conversion is practised here.
- Garden wastes from the site are also included in this compost bed.

Figure 8: Outside Composite Bed

Duck Cycle

- These ducks feed on the larvae, fish wastes and some portion of organic waste. A duck lays around 30 to 40 eggs.
- But ducks don't have the habit of incubating its eggs, thus most of the eggs fail to hatch.
- In order to gain complete hatch rate of the eggs, the eggs are placed under a group of hens incubating its own eggs.
- A total of 40 to 45 days are taken for an egg to hatch.
- These eggs sell at a cost of Rs.8 per egg. These eggs are believed to have medicinal values such as a treatment for piles.

CATTLE EXCRETA CYCLE

- A herd of 12 cows feed on organic waste materials.
- A minimum of 35kg of food should be fed to these cattle.
- From the time of feeding, it produces cow dung in 8 hours. It produces around 10 to 15kg of dung per day.
- Cow's urine has its own medicinal and commercial values; hence it is collected and stored for several purposes.
- Cow's urine left after taking away the required quantity for production is pumped and sprayed over the plantations inside the premises for better yield.

Figure 9: Cattle Excreta Cycle

Panchakavyam Production

- A highly effective organic fertilizer named as "**PANCHAKAVYAM"** is produced from a combination of various by-products; it is a liquid which is made up of mixture of milk, cow dung, ghee, cow's urine, jaggery (karupatti), curd, banana, tender coconut. This mixture is incubated and liquidized after 15 days.
- This panchakavyam is manufactured by mixing the above combinations and stirring for 15 minutes clockwise and 15 minutes anti-clockwise twice a day once in the morning and evening. It is ready for use when it produces the smell of mango.
- This fertilizer is effective in strengthening the plants and generating extra yield from the plant. It can also be used to bring a decaying plant back to life. All its features have been tested and documented and the chemical composition of this fertilizer has been tested and statistically provided by "**ALPHA LABS".**

Insect Repellent Production

Another highly commercial product produced from these raw materials is **"POOCHI VERATI"** it is an insect and fly repellent. It is produced using the following process:

- The raw materials required are10 litres of cow urine, leaves of the Neem plant (veppilai), Papaya leaves, Custard apple (seethapazham), five leaved chaste tree (Nochi ellai), crown flower plant leaves (errukan poo ellai).
- 2 kilograms of each plant leaves are ground separately with 2 litres of urine separately and then all are mixed together and stirred clockwise for 15 minutes in the morning and 15minutes in an anti-clockwise in the evening for 15 days then the liquid repellent is ready for use when it produces a pungent smell.
- This repellent does not kill the insect, but merely repels them.

Methane Gas Production

Cow dung is also used for producing methane gas, which is used for cooking within the premises.

300kg of cow dung is capable of producing enough methane gas to fill a commercial cylinder if extracted efficiently.

The procedure followed for producing, storing and utilizing methane gas is as follows:

- The collected cow dung is mixed with warm water at a temperature of 50^{o}C Celsius in a ratio of one kilo cow dung to 1 litre of water along with food and fruit wastes rich in carbohydrates.

- The purpose of adding heated water is to avoid mixture of sulphur, CO2 etc. with Methane gas.
- If these chemicals are mixed with methane it produces a blue flame while burning.
- This mixture, which is called as "**SLURRY"** is filled in a main tank which is a 7feet capacity tank and it is maintained in vacuum, over period, methane gas is generated which is circulated via six other methane collection tanks in order to extract methane effectively.
- Each of these collection tanks has one inlet and two outlets, the methane produced in the first tank mixed with slurry is given as inlet and extracted methane flows out through one of the outlets to the storage balloon and the remaining slurry with methane overflows to the next tank and the same process continues in all 6 tanks until the maximum ratio of methane is extracted from the slurry in the process.
- The subordinate tanks have a capacity of 7feet, 6 feet, 6feet, 5.5feet, 5feet, 4.5 feet respectively. It extracts methane as to 20%, 20%, 15%, 15%, 10%, and 5% in the 6 tanks respectively. Therefore, 85% of methane is extracted from the slurry.
- The produced methane gas is collectively stored in a gas balloon of 60 cubic meters and supplied to the community kitchen for cooking, each day up to 200-250 people are served from the food prepared in this kitchen.

Figure 10: Methane Gas Production Unit

VERMI CAST PRODUCTION CENTRE

The methane extracted slurry is then pumped and passed into the earthworm production centre. There the slurry is allowed to dry for 72 hours, and then it is piled in open sunlight for 10 days. During the course of this process, it is watered twice a day to cool it down, then it is powdered and used as food for earthworm production. African earthworms are more effective in reproduction and it produces more useful by products such as phosphorous, potassium, nitrogen hence African earthworms are most sought after. These earthworms are bought as a one-time investment and then onwards it is internally bred and reproduced in a continuous cycle. The Vermicast production undergoes the following procedure:

Figure 11: Vermicast Production Centre

- Tank shaped vermicast production beds are designed to be 8feet in length and 2 feet in breadth. This measurement is made for ease of collection of materials from the tank by the collection personnel from both sides of the tank.
- The tank is 2 feet deep and its base is designed in such a way that it is a slope and the liquids produced in this tank will slide down and is connected to an underground tank with a filter which extracts only the liquid.
- The tank is initially filled with 20 centimetres of small, cleanly washed stones, then 10 centimetres of concrete sand and the third layer consists of fibrous materials such as coconut coir, the fourth layer is made of normal sand.
- Then the collected and processed dry slurry is filled for the remaining capacity of the tank with a space of 1metre left over at the top of the tank.
- Initially three kilograms of earthworms are mixed with this slurry. If the tank capacity is twice the measurement of the above mentioned tank, then twice the quantity of earthworms should be filled initially.
- These earthworms feed on this slurry and excrete extremely utilisable fertilizing materials and lays eggs, thus producing the next batch of earthworms.
- There are 17 such tanks in this production centre and at an average produces 400kg of fertilizer materials.
- This tank consisting of a complete set of manures is watered twice a day. This water flows through all these layers and also includes the sweat of the worm and collectively flows down to the underground tank through the filter.
- This liquid collected in the underground tank is known as "**VERMI WASH"** which is a strong and effective plant fertilizer which helps in expanding the life span of a plant and increasing its yield.
- Each day the top layer of these tanks are collected by bare hands and piled on the ground, cow dung mixed with water is sprayed on this piled collection and this forms a layer. Similarly 10 layers, each of 40kg, are laid one over the other to form a big pile bed of collecting material. This pile is covered by a jute sack and is left undisturbed for 45 days.
- During this period, the jute cover gradually disappears as it is decomposing, when the jute sack completely disappears, it indicates that the eggs of earthworms have completely formed into a cocoon. From 400 kg of such manure 40000 earthworms are produced.

- The produced earthworms are again included in the next cycle of producing manures and fertilizers such as VERMI WASH. Thus, this vermicast production centre becomes self-sustainable and does not require any foreign raw materials for production.

INORGANIC WASTE - TERTIARY SEGREGATION

The inorganic wastes collected from the secondary segregation sites are brought to the tertiary segregation site for splitting it into its subcategories based on its commercial usage and value. The major classifications are listed below:

- Paper
- Plastics
- Plastics covers
- Aluminum
- Rubber
- Bottles
- Batteries
- Metals
- Clothes

Figure 12: Inorganic wastes

Summary

Thus the Kurudamapalayam Panchayat's CASTAS project is a self-sustained modern science master piece which is eco-friendly as well as regenerative and profitable. This project is to be taken up more seriously and followed all over India.

CONCLUSIONS

Following the colossal success of the CASTAS project at Kurudampalayam, Madukkarai Block is all set to follow suit. Infrastructural preparations are in full swing as of October, 2014. Having completed an exhaustive survey of their corresponding localities, SS Kulam and Thondamuthur blocks are next in line. Cognizant Technology Solutions and Larsen

& Tourbo have come forward to help with the CASTAS projects at SS Kulam and Thondamuthur respectively. The DRDA is focused on making all the 12 blocks under it sustainable waste management centres.

REFERENCES

1. *Abdullahi, Y. A. (2011). "Waste to Wealth: Agricultural Engineers Approach", A Presented at a public Lecture organized by Nigerian Institute of Agricultural Engineers (NIAE),Kaduna State Chapter. Mohammed Dikko Lecture Theatre, Kaduna Polytechnic, 10thNovember.*
2. *Bhide, A.D. and Sundaresan, B. B., 2001. "Solid Waste Management, Collection, Process and Disposal", Mudrashipa Offset, Nagpur.*
3. *Coad, A., 2005. "Private Sector Involvement in Solid Waste Management - Avoiding problems and building on successes". CWG Publication Series Number 2. Switzerland. ISBN: 3-908156-09-2.*
4. *Coad, A and Coffey, M., 2008. "Collection of Municipal Solid Waste in Developing Countries". (Volume 1 of Waste Management Series). UN Habitat, Kenya.*
5. *Environmental Status Report of Amravati City Amravati Municipal Corporation Office of Public Health Officer, AMC.*
6. *Haan, H. C., Coad, A. & Lardinois, I. (1998). Municipal waste management: Involvingmicro-and-small enterprises. Guidelines for municipal managers. Turin, Italy:International Training Centre of the ILO, SKAT, WASTE. Retrieved on May 14, 2012, from http://www.skat-foundation.org/publications/waste.htmbn*
7. *Puri A., Kumar M., 2008. "Solid waste management in Jalandhar city", Indian journal of occupational and Environmental medicine, Vol. 12, issue-2.*
8. *Schubeler, P., 1996. "Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries". UNDP/UNCHS Working Paper No 9.*
9. *Techobanoglous. G, Theisen H, Vigil S., 2001. Integrated Solid Waste Management. Engineering principles and management issues. Mc Graw– Hill.*
10. *Upadhyay V.P., Prasad Rajeswar M., Srivastav Ajay and Singh Khazan., 2005. "Eco Tools for Urban Waste Management in India", Journal of Human Ecology, 18(4) : 253-269.*
11. *Victor, I. & Choji, I. D. (2006). "Composting: A viable option for urban waste management in Nigerian cities". Environ. J. Environ. Stud., 2(5).*
12. *Wilson, D., Whiteman, A. & Tormin, A. (2001). Strategic planning guide for municipal solidwaste management. Washington, DC: World Bank. Retrieved on December 25, 2011,from http://www.worldbank.org/urban/solid_wm/erm/start_up.pdf*
13. *Wilson, D., Whiteman, A. and Tormin, A., 2004. Strategic Planning Guide for Municipal Solid Waste Management. Environmental Resources Management (ERM). www.worldbank.org/urban/solid_wm/erm/start_up.pdf.*